Climate Change Fuel Cell Program

OCM BOCES
200 Kilowatt UTC PC25C Fuel Cell

Final Report

Report on Five (5) plus years of Operating Experience
From January 25, 1997 COD through September 23, 2002

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Disclaimer:

Abstract:

The Onondaga-Cortland-Madison Board of Cooperative Educational Services (OCM BOCES) installed the 200 kW PC25C Fuel Cell in the fall of 1996. Prior to the installation and operation of the Fuel Cell, the OCM BOCES School system had experienced considerable computer interruption and downtime attributed to normal utility grid fluctuation. This computer downtime created significant time loss and financial expense to OCM BOCES. Since the Fuel Cell installation and initial operation in January, 1997, the School has not experienced a single critical loss of its computer system. A quarter cycle transfer switch (installed with the Fuel Cell) has provided the ability to effortlessly switch back to the utility grid during times of Fuel Cell maintenance. The utility grid has become the "Backup Power" with the Fuel Cell providing the "Primary Power" to the entire building housing the critical computer system.

A review of the information provided in this report will show that the UTC Fuel Cell PC25C unit has performed successfully in this mission-critical high availability and high power quality application.

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Executive Summary

The PC25C Fuel Cell installation began in October, 1996 with OCM BOCES issuing a contract to Niagara Mohawk Energy (then under the name of Plum Street Enterprises). The exterior installation was completed and the unit went commercial on January 25, 1997. The installed cost to OCM BOCES consisted of $760,000 for the Fuel Cell material unit and $250,000 for the installation components and labor. These costs were offset by a $200,000 grant from the US Department of Energy, and a funding of $331,212 by the New York State Energy Research and Development Authority.

The main purpose for the installation was to ensure constant/continuous power to OCM BOCES computer facility. This facility (the Regional Information Center) was responsible for storing information for 52 school districts in Central NY, all student records, report cards, attendance, and financial records. This Facility had been experiencing loss of its computer network due to utility grid fluctuations/ disturbances. These interruptions were costly and time consuming, and were getting more and more frequent.

The Fuel Cell installation has virtually eliminated this problem. The high "premium power quality" of the Fuel Cell coupled with the ability to rely on the utility grid as "backup" has provided the solution which has proved itself over the last five (5) plus years of operation.

Not only has the system met the continuous power requirement, but also the installation has provided significant savings in electricity costs, and also supplied beneficial supplemental building heat, thereby reducing heating costs.

Introduction:

- In the fall of 1996, the Fuel Cell was purchased from UTC Fuel Cells (then under the name "ONSI").
- OCM BOCES contracted with Niagara Mohawk Energy (then Plum Street Enterprises) to install the Fuel Cell. Niagara Mohawk Energy began the installation in October, 1996 and completed the installation in January, 1997.
- The Fuel Cell is installed in a Grid Independent configuration; with the unit providing the primary building power, using the utility grid as backup. The power is transferred from the Fuel Cell to utility grid via a quarter cycle transfer switch located within the facility.
- The Fuel Cell is located adjacent to the Regional Information Center in a fenced in area (an exterior installation). Appropriate landscaping has been added to enhance the visual aspect of the installation and to coordinate with the remainder of the building grounds.
- OCM BOCES has contracted with Niagara Mohawk Energy to provide Operations and Maintenance services since commercial operation.
- The Fuel Cell was purchased with the High Grade Heat Option. Initially, this option was not put into use. But, in the fall of 2000, appropriate modifications to the building heating system were incorporated, and the Facility has been experienced the benefits of the "free" Fuel Cell supplemental heat over the last 3 winters.

Mean Time Between Failure and Reliability/Availability:

Fuel Cell Operation and Maintenance (non-routine/non-scheduled) by year ---

!st Year - 1997

- HEX #410 – 2/97
- Valve CV-500 - 3/97
- Various Drag Brakes - 5/97
- Replace HEX #400, HEX #431– 5/97
- Replace Pump 450, 451 – 5/97
- Quad Power Supply Replacement - 7/97

2nd Year – 1998

- Replace Inverter Drawer #2 – 1/98
- High Grade Heat Exchanger Retrofit – 1/98
- Replace Pump #400 – 1/98
- Inverter Drawer #4 Slave Card - 5/98
- HEX 800 Motor Retrofit – 7/98
- LC #451 Control Valve – 7/98

3rd Year – 1999

- Replace Muffin Fan – 4/99
- Replace Gate Cards; Inverter Drawer #1 – 6/99
- Replace Controller Fan – 7/99
- Replace Pump #451 –7/99

4th Year – 2000

- FCV #110 Drag Brake and motor bearings replaced – 1/00
- Replaced resistor on Ejector Module – 1/00
- Replace Inverter #2 Gate Cards - 2/00
- Replace Inverter #2 Hi Volt Card & 3 LEMs – 2/00
- Replace Reformer – 5/00
- Replace Inverter #2 LEMs (3) – 6/00
- Replace Blower #100 motor – 6/00
- Replace Inverter #2 Slave Card – 6/00
- Rebuild CV 500 valve – 6/00
- Replace UPS Batteries – 8/00

5th Year – 2001

- Replace Quad Power Supply – 4/01
- Replace Hi Volt Cards; Inv. Drawer #1,2, & 4 - 4/01
- Replace 2 Inv. Drawer #4 Drive Gate Cards – 6/01
- Replace Inv. Drawer #2 – 6/01
- Replace Fan #800 Controller – 6/01

- Install 2 UPS Batteries – 10/01
- Replace (3) Fan 800 Motors – 12/01

6th Year – 2002

- Replace Pump #451 – 4/02
- FCV #110 replaced – 4/02
- Rebuild CV500 – 4/02
- Replace ILS Heater Strips (2) – 4/02
- Inverter Drawer #2 Problems; replaced Master DSP – 6/02
- Replace HEX 800 Fan Motors – 6/02, 7/02
- Replace FT012 Flow Transmitter – 7/02
- Inverter Drawer #2 Problems; replace (3) LEM's – 7/02
- Inverter Drawer #2 Problems; replace (3) Hi Volt Card – 7/02
- Replace #6 Slave Card – 7/02

Availability (Year 1 through current):

Cumulative Load Time Hours

	Recorded	Calculated	
Thru 1997 =	7231		(7423 Load hrs recorded thru 1/8/98 less 8dys times 24 hrs)
Thru 1998 =	14276		
Thru 1999 =	22105		
Thru 2000 =	30401	30483	(through 12/31/00 @midnight).
Thru 2001 =	38848	38812	(through 12/31/01 @midnight)
Thru 2002 =	44446		(through 9/23/02 @1:30pm)

	Annual Availability		
1997 Availability =	88.7%		
1998 Availability =	80.4%		
1999 Availability =	89.4%		
2000 Availability =	95.3%		
2001 Availability =		95.1%	(through 12/31/01 @midnight)
2002 Availability =		88.4%	(through 9/23/02 @1:30pm)
Total Availability =	89.6%	avg.	From COD to 9/23/02@1:30pm

Overall, the Fuel Cell has been available about 90% of the time with the utility grid providing the backup power for the remaining 10% of the time.

Cost Benefit:

Savings –

Over the past 5 plus years of operation (1/25/97 through 9/25/02), the Fuel Cell has generated a total of 4,109.6 MWh.

Assuming a nominal average cost of electricity in the Syracuse NY area equal to 12 cents per kWh, the Fuel Cell has generated **an electricity savings of approximately $493,000**.

Fuel Costs –

Over the past 5 plus years of operation (1/25/97 through 9/25/02), the Fuel Cell has used 37,279,932 scfh of natural gas. This equates to approximately 37,280 DT of natural gas.

Assuming a nominal average cost of natural gas in the Syracuse NY area equal to $5 per DT, the Fuel Cell **has cost OCM BOCES $186,400 in fuel cost**.

We have purposely ignored the cost of Operations and Maintenance in this comparison. OCM BOCES knew full well that the Fuel Cell was "new technology" and as such recognized that O&M costs may be higher than with "traditional technology" generation. However, the main purpose of the Fuel Cell installation was for the Un-interruptable Power and to eliminate the loss of Computers at the Regional Information Center. **The Savings associated with the fact that the computers have not experienced a loss since the Fuel Cell installation, far outweighs the cost of the O&M.**

In addition to the benefits achieved as listed above, the use of supplemental Fuel Cell heat has **saved an estimated $300 to $800 per year** over the last three heating seasons. This amount would be much higher if the Fuel Cell were to be operated at full 200kw load, however in our application the load averages anywhere from 85 to 155 kW each day. Thus the lower heat output and associated savings.

Thermal Output:

As stated above, the High Grade Heat Option was purchased with the Fuel Cell. However, use of the supplemental heat was not placed into operation until the year 2000 heating season when modifications were made to the existing building heating system. The heat recovered from the Fuel Cell is not metered, so actual heat recovery figures are not available.

As per UTC Fuel Cells literature, "the high grade heat decreases to zero at approximately half rated power". Normally the High Grade Heat Option provides 300,000 BTU/hr of heat at 200kw. But, the OCM BOCES Fuel Cell operates somewhere between 85 to 155 kW each day. In the winter, the load is somewhat less throughout the day since the A/C

load is reduced (only computer A/C load is seen in the winter months). Therefore, the Fuel Cell provides some supplemental heat only when the loads are between 100 kW and the maximum load, which may be as high as 150 kW.

This supplemental heat is mixed at the normal Building Boiler (through a heat exchanger); flowing through the boiler and into the building; thus reducing the requirement for the boiler to cycle on as much and thereby reducing the natural gas usage.

Certification:

OCM BOCES certifies that it has complied in all aspects with the requirements of the grant DE-FG21-96MC33337 and that the related efforts required by that grant are now fully complete including 5 plus years of operation and submission of this Final Report. Such report is in compliance with the Department of Energy's special Terms and Conditions for Research Projects Grants for the Climate Change Fuel Cell Program.

Conclusion:

OCM BOCES has been very pleased with the PC25C's performance over the past 5 years plus of operation. As stated above, the availability is averaging 90%, and the installation has solved a major computer downtime problem that OCM BOCES had been routinely experiencing. The Fuel Cell has made a monumental contribution to the integrity of our operations and to our commitment to the 52 school systems that we serve. We are pleased and proud that OCM BOCES was a leader in being one of the firsts to install a Fuel Cell in a school setting.

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